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INT CL^{6} H04B 1/38, H04M 1/02 1/60 1/62 1/72

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(54) Communication device whose mode of operation is controlled by position of detachable and rotatable housing

(57) A communication device 104 includes two housings 108, 110 each containing circuitry for operating the communication device 104 in different modes (Figure 7). The communication device 104 includes a latch (112, Figure 5) for rotating one housing with respect to the other or detachably coupling the two housings 108, 110. The device 104 switches between different operating modes based on the attachment, detachment or relative position of the two housings 108, 110. Different operation modes are selected both by the position of the latch switch (112) and the user and include telephone, video conferencing, camera, phonebook and notepad modes. Details of the operation of the latch switch and the signal processing are given.

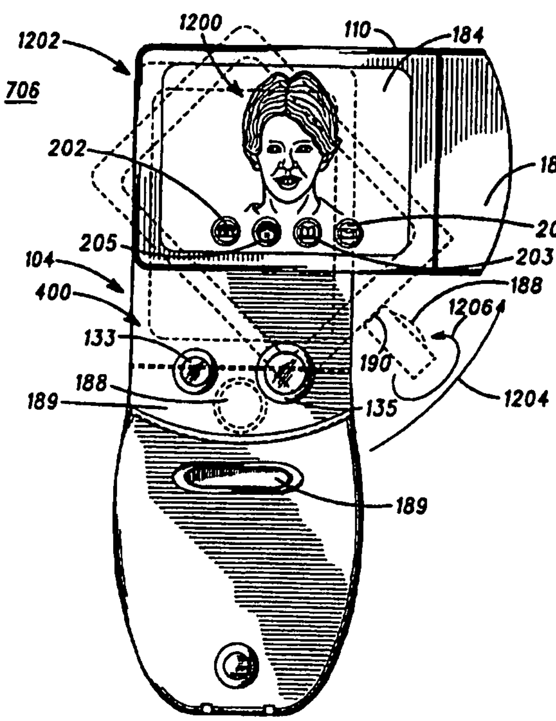

FIG.12

GB 2 315 186 A

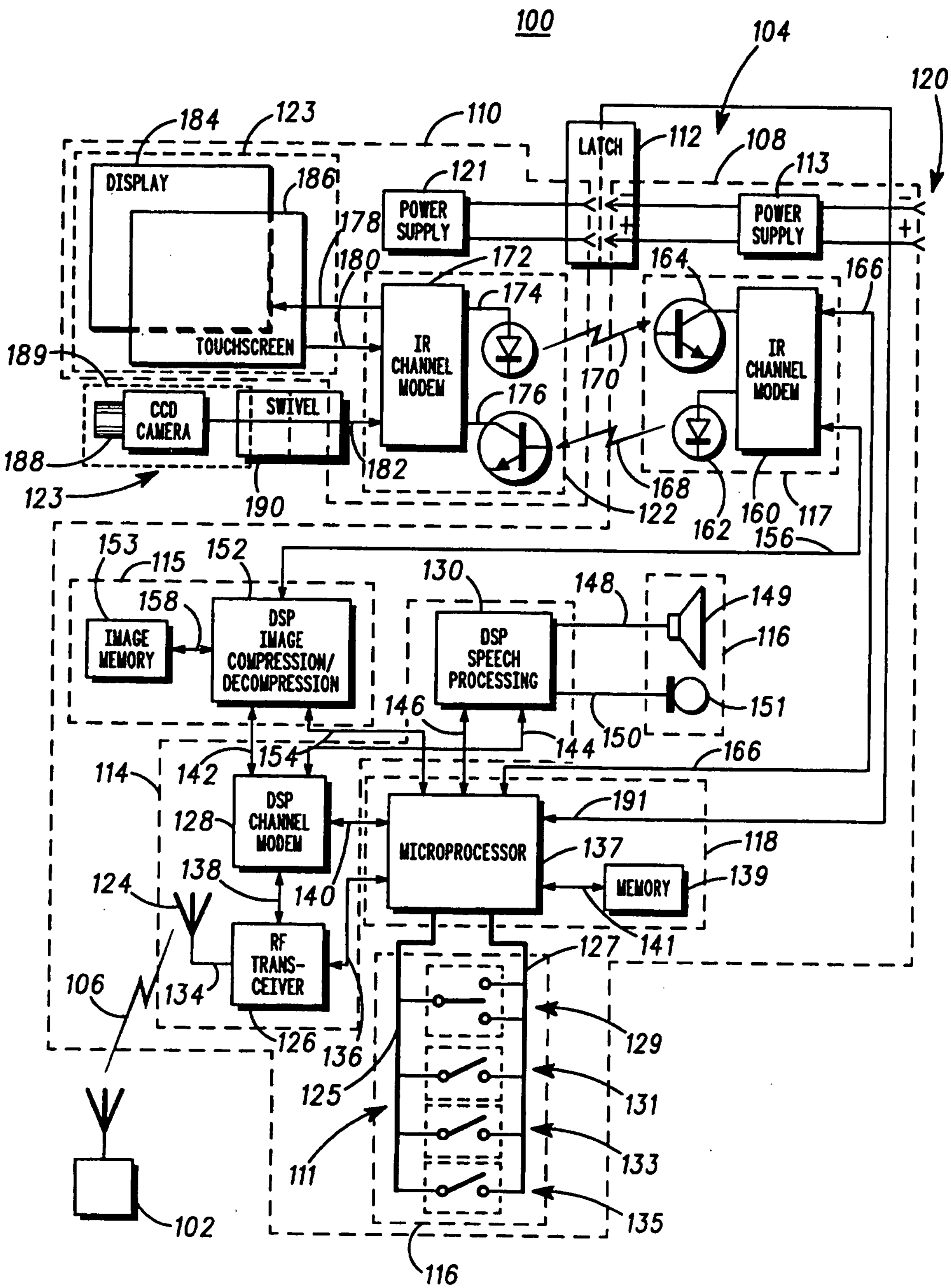
100
104
120
184
123
110
112
108
113
DISPLAY
186
121
POWER SUPPLY
LATCH
POWER SUPPLY
178
180
172
164
166
174
IR CHANNEL MODEM
IR CHANNEL MODEM
TOUCHSCREEN
189
176
170
CCD CAMERA
SWIVEL
188
182
168
123
190
122
162
160
117
156
153
115
152
130
148
149
158
IMAGE MEMORY
DSP IMAGE COMPRESSION/ DECOMPRESSION
DSP SPEECH PROCESSING
116
146
151
154
144
150
142
166
114
128
DSP CHANNEL MODEM
191
MICROPROCESSOR
137
118
124
138
140
MEMORY
139
141
RF TRANS- CEIVER
127
106
134
129
126
136
131
125
133
111
135
102
116

FIG.1

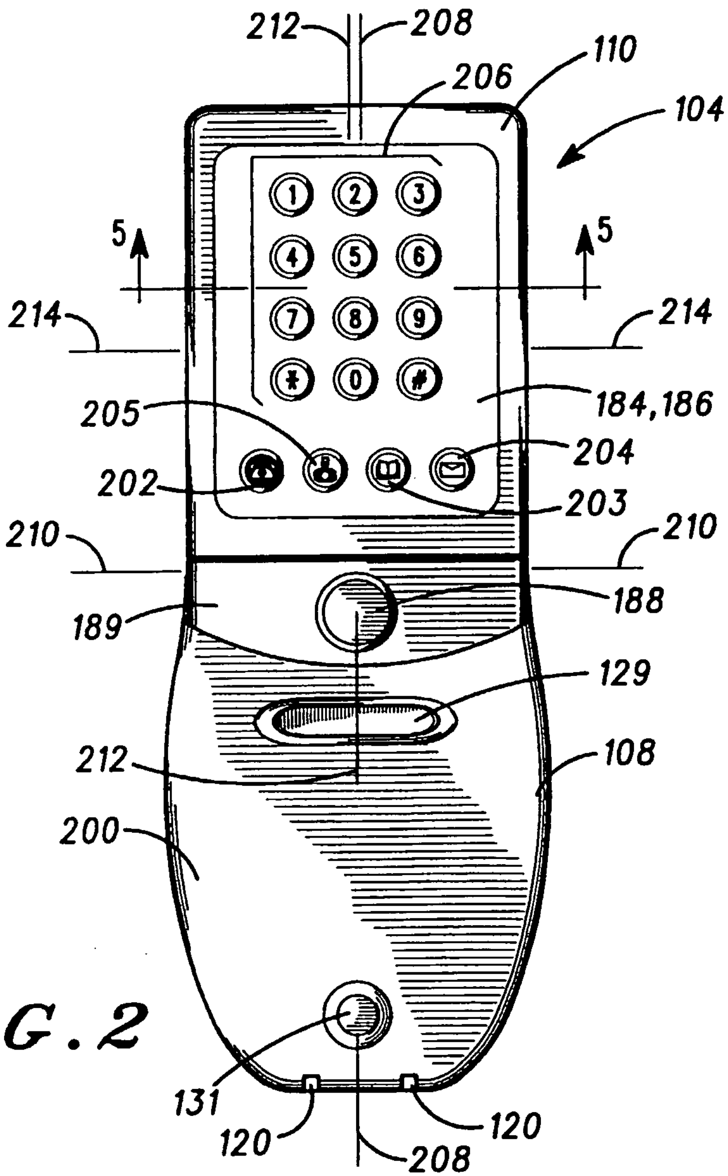
212
208
206
110
104
5
5
1
2
3
4
5
6
7
8
9
*
0
#
214
214
184,186
205
204
202
203
210
210
189
188
129
212
108
200
131
120
120
208

FIG. 2

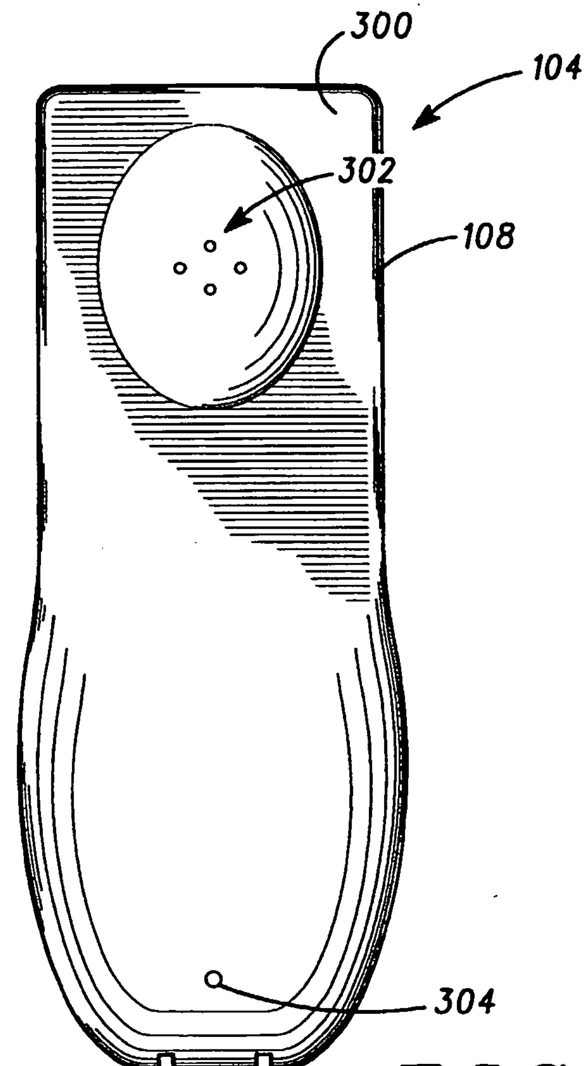
300
104
302
108
304

FIG. 3

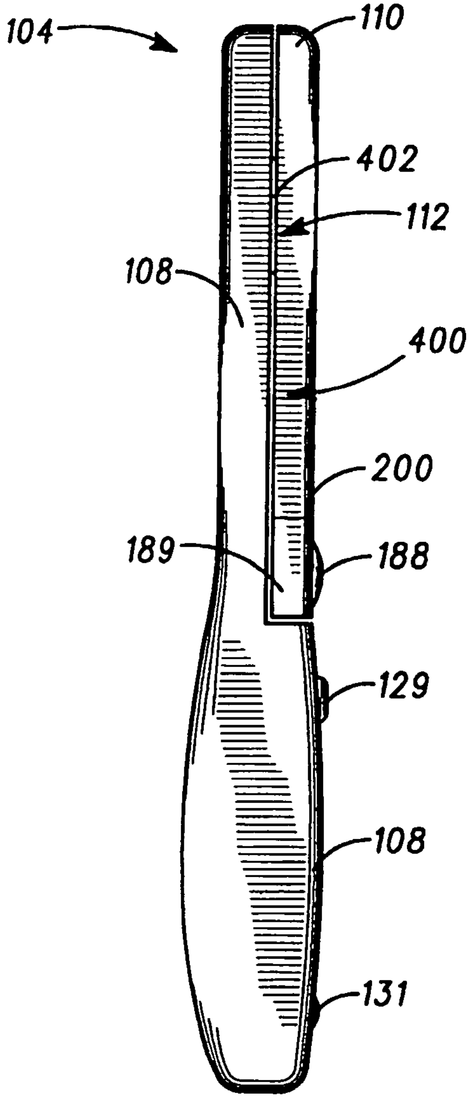
104
110
402
112
108
400
200
189
188
129
108
131

FIG.4

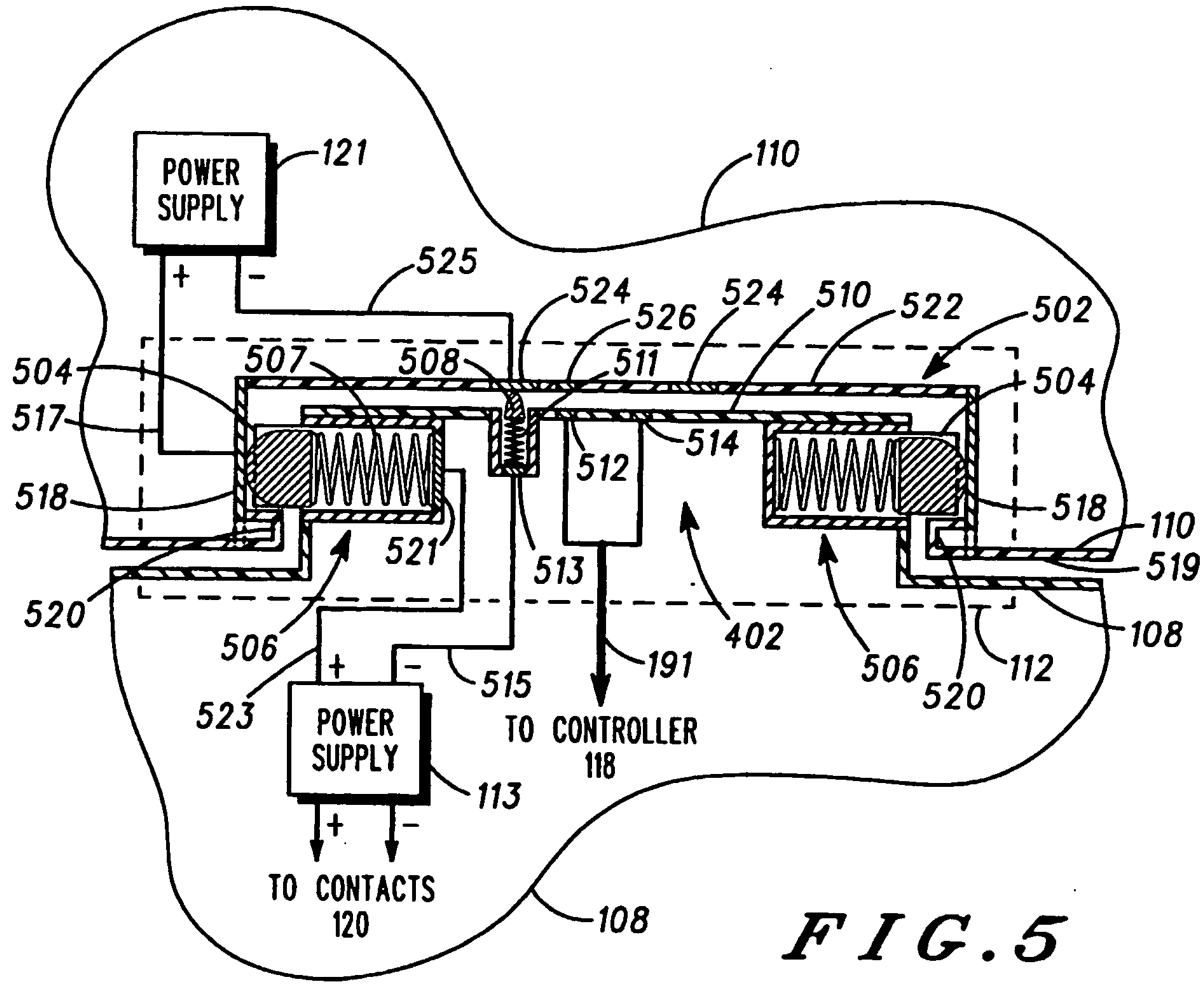
POWER SUPPLY
121
110
525
524
524
510
522
502
526
508
511
507
504
504
517
512
514
518
518
110
521
513
519
520
108
506
402
523
515
191
506
520
112
POWER SUPPLY
TO CONTROLLER 118
113
TO CONTACTS 120
108

FIG.5

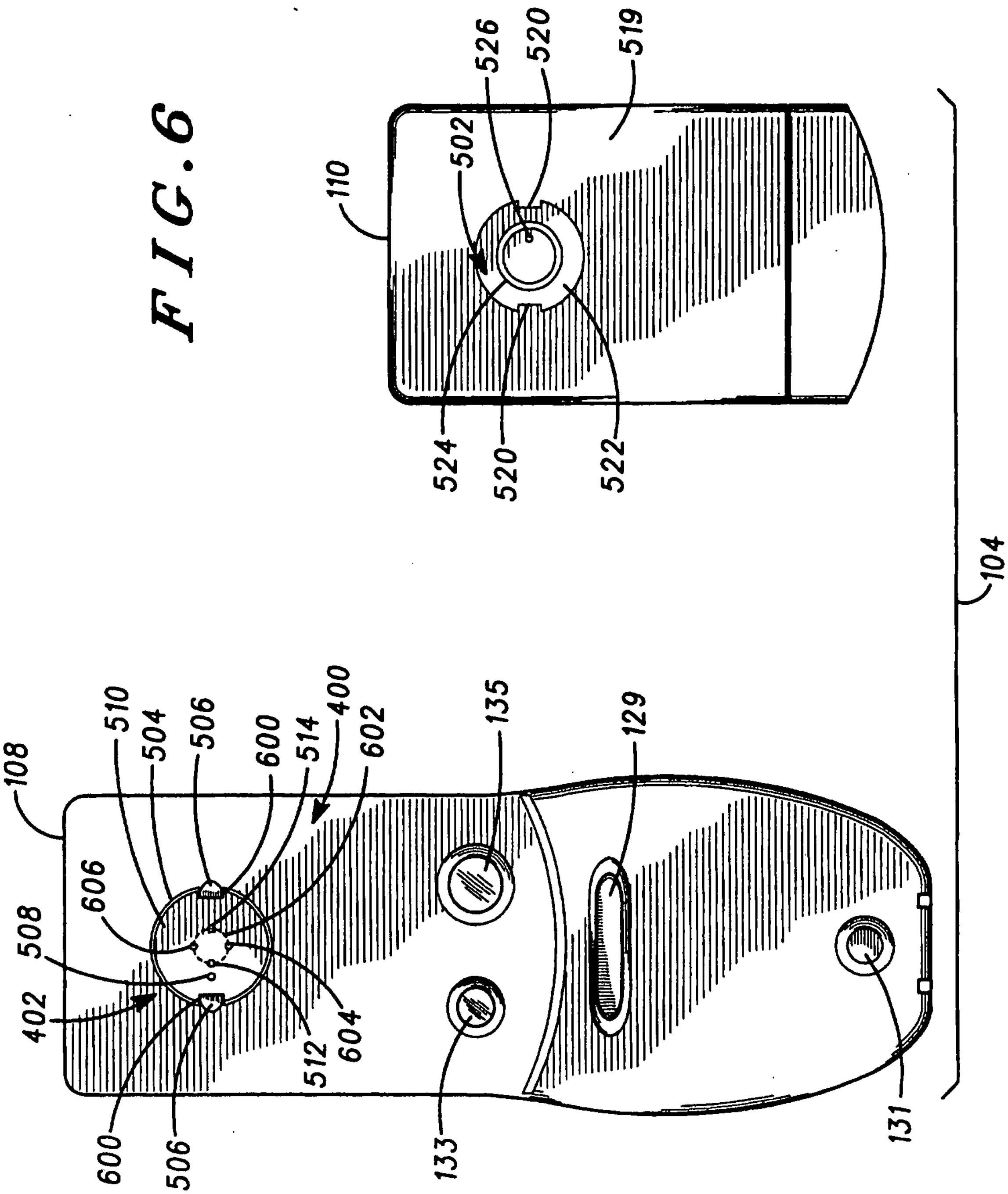
108
510
504
506
600
514
400
602
606
508
402
512
604
600
506
135
129
133
131
104
110
502
526
520
519
524
520
522

FIG. 6

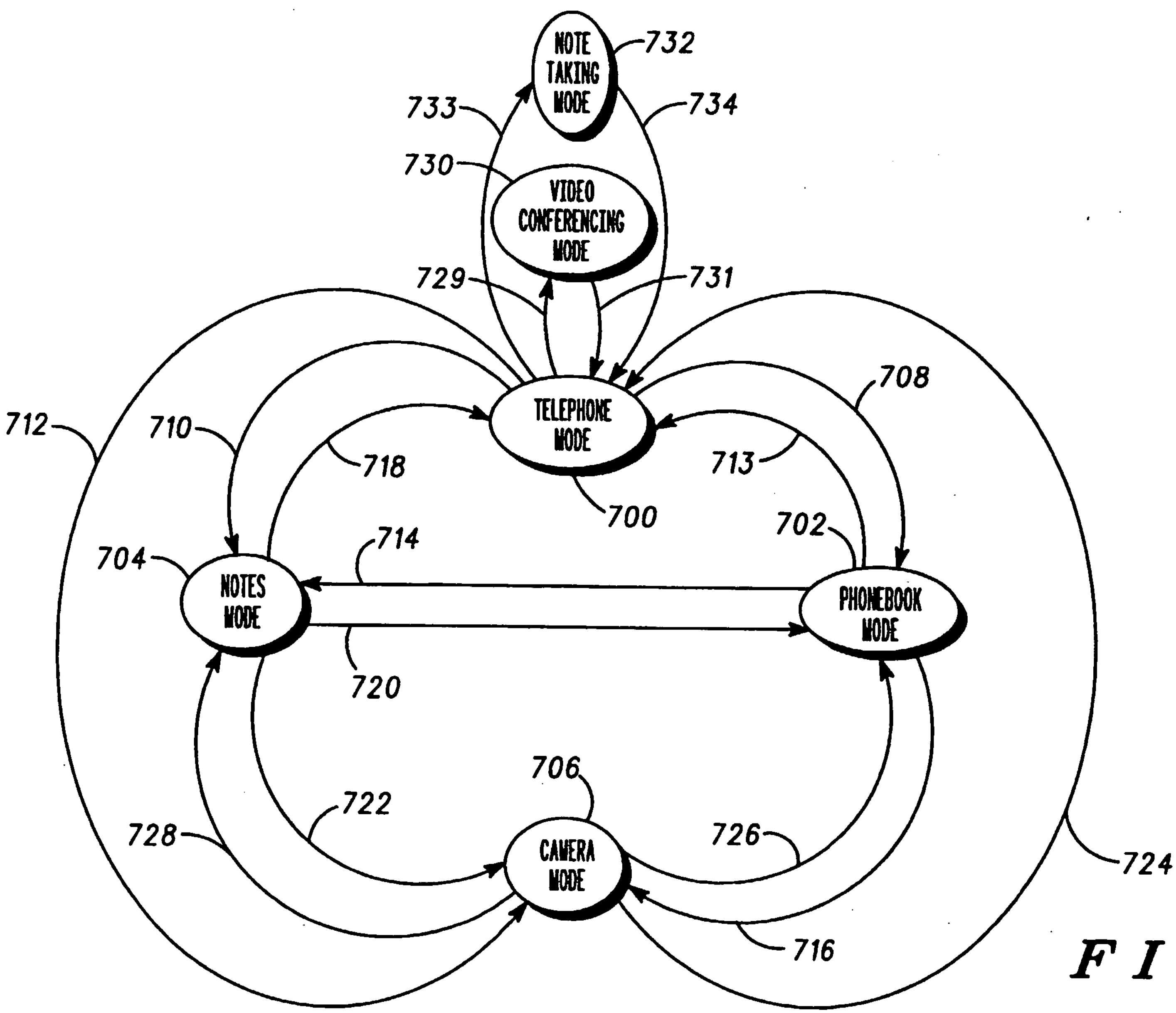
NOTE TAKING MODE
732
733
734
730
VIDEO CONFERENCING MODE
729
731
712
710
TELEPHONE MODE
708
718
713
700
702
704
714
NOTES MODE
PHONEBOOK MODE
720
706
722
728
726
CAMERA MODE
724
716

FIG. 7

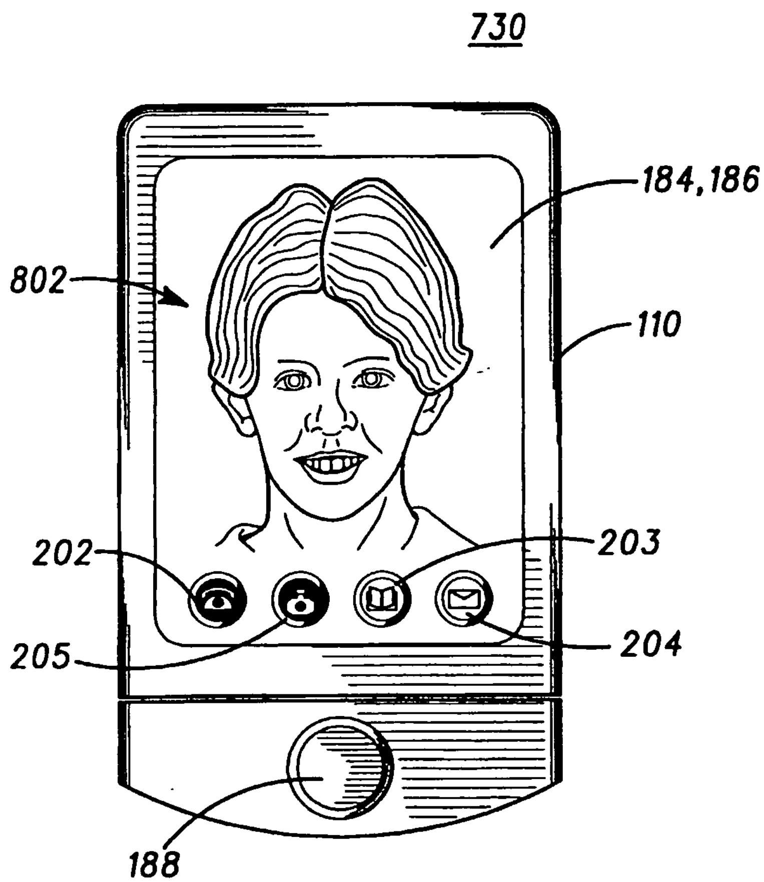
730
802
184,186
110
202
203
205
204
188

FIG.8

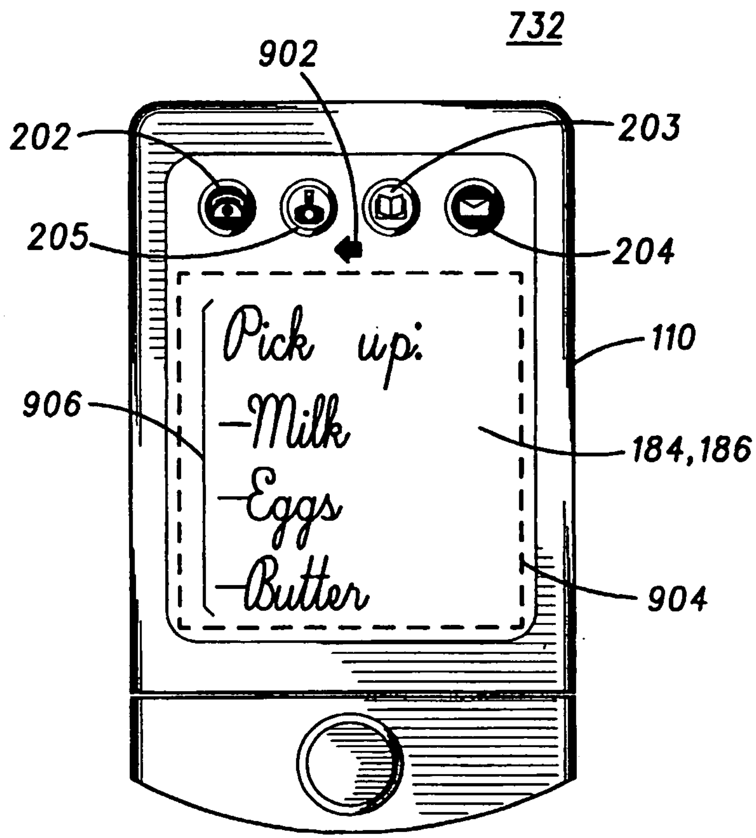
732
902
202
203
205
204
110
906
184,186
904
Pick up:
—Milk
—Eggs
—Butter

FIG.9

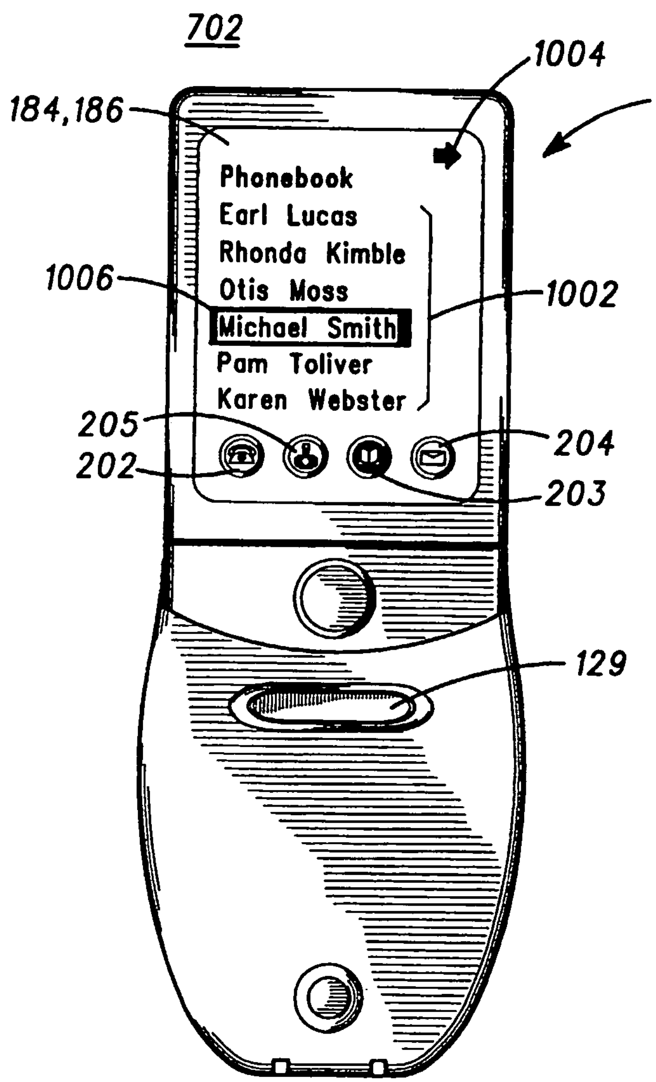
702
1004
104
184,186
Phonebook
Earl Lucas
Rhonda Kimble
1006
Otis Moss
Michael Smith
1002
Pam Toliver
Karen Webster
205
202
204
203
129

FIG.10

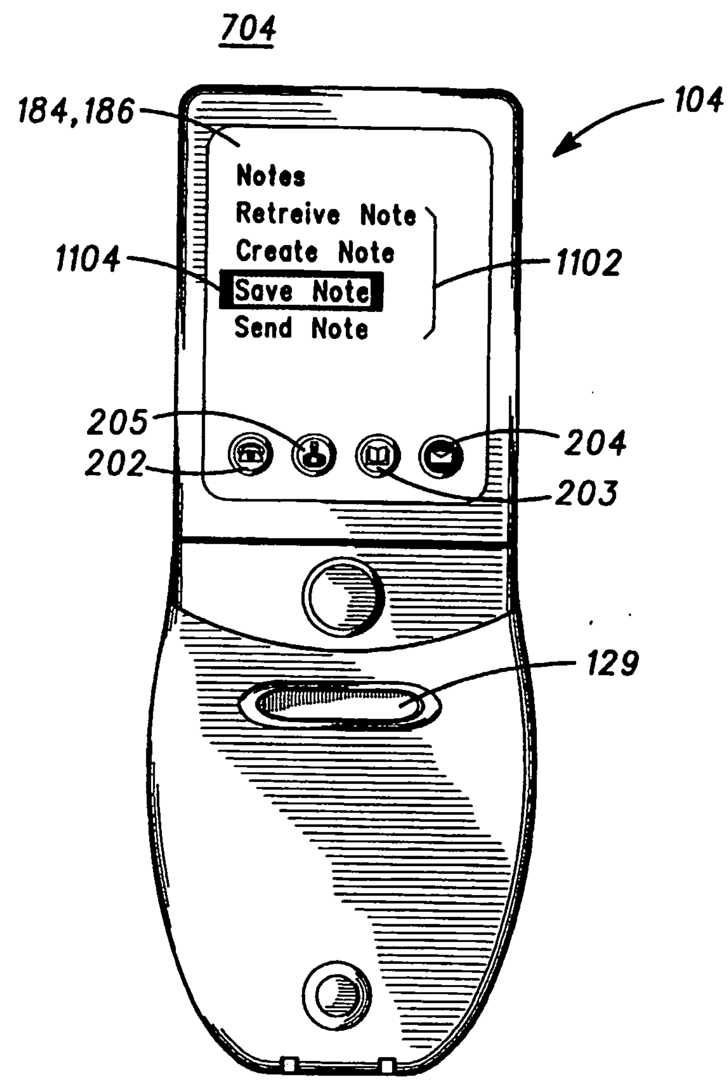
704
104
184,186
Notes
Retreive Note
1104
Create Note
Save Note
1102
Send Note
205
202
204
203
129

FIG.11

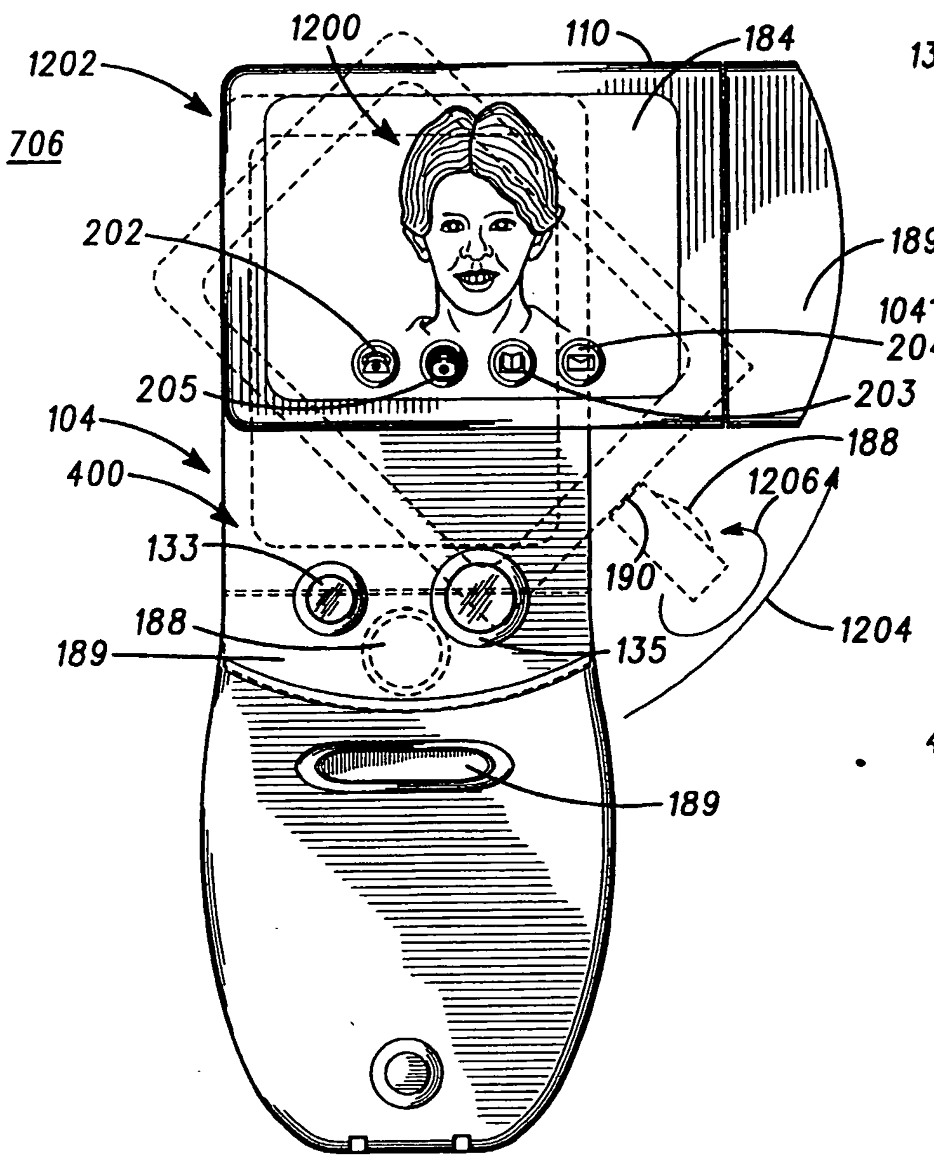
706
1202
1200
110
184
202
189
204
205
203
104
400
188
12064
133
190
1204
188
189
135
189

FIG.12

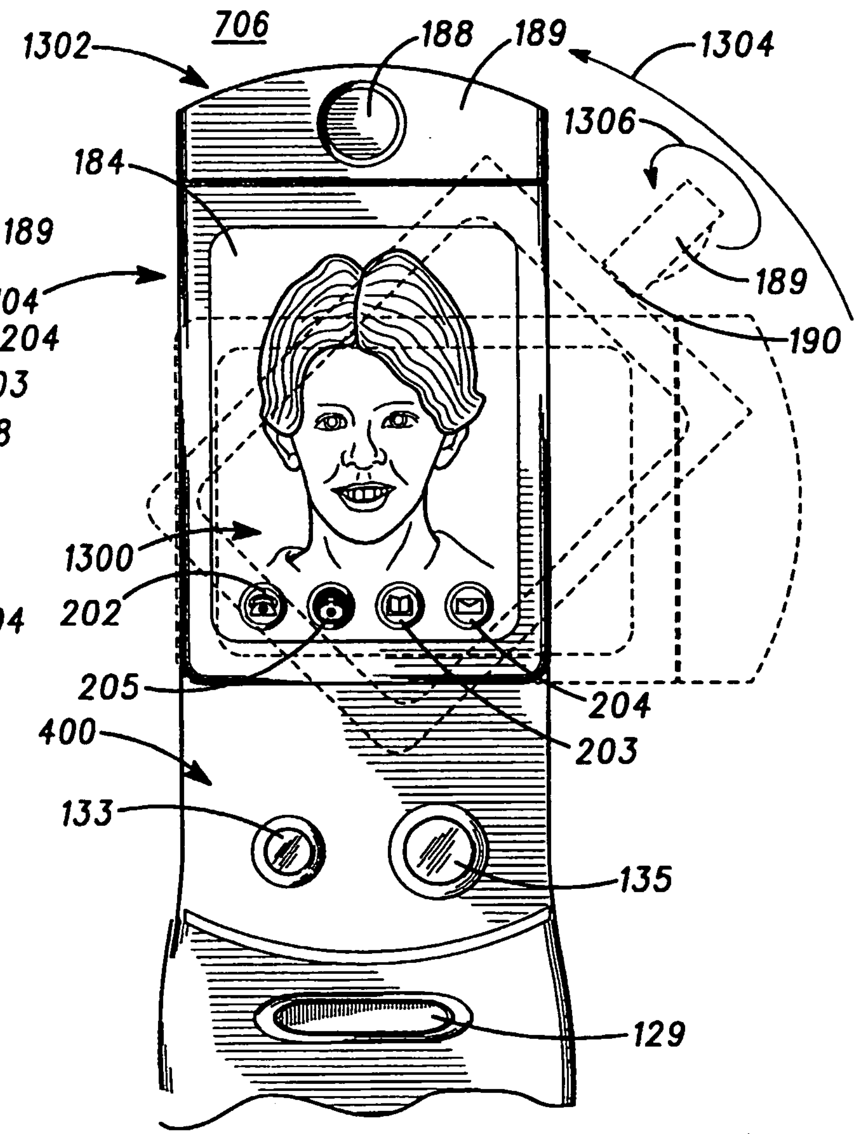
1302
706
188
189
1304
1306
184
189
104
190
1300
202
205
204
203
400
133
135
129

FIG.13

2315186

COMMUNICATION DEVICE

Field of the Invention

The present invention relates generally to a communication device and more specifically to a multi-mode communication device.

Background of the Invention

Recently, there has been an increased demand in the marketplace for multi-mode communication devices. In response, manufacturers have proposed giving traditional audio telephones video capability. Traditional audio telephones, such as portable radiotelephones, include a user interface carried on a single housing. The user interface comprises a speaker, a microphone, a display, and a data input device, such as a keypad. These telephones are typically used to initiate a call to another user via the keypad. Once the call is initiated, the user positions the telephone in close proximity to his or her ear and mouth so as to listen to the speaker and speak into the microphone, i.e., communicate audibly, with the other user. During use, the telephone is positioned such that the user is unable to view or utilize the display.

To accommodate the video capability, it has been proposed to replace the display of the traditional audio telephone with a larger display, such as a color liquid crystal display, and mount a camera, such as a charge coupled device (CCD) camera, on the single housing in proximity to the display. It has been further proposed to enhance the microphone and speaker of the traditional audio telephone with

speakerphone capability. The resulting multi-mode communication device allows the user to hold the communication device away from his or her head and communicate with another user both audibly via the enhanced microphone and speaker and visually via the larger display and camera. Unfortunately, such a device must have a single surface that is at least large enough to carry the larger display, camera, and enhanced speaker and microphone. This results in a dimensionally larger device. Also, the speakerphone enhancement prevents the user from positioning the device in close proximity to his or her ear and mouth to, for example, communicate in privacy or in the presence of loud ambient noise.

Other proposed multi-mode communication devices combine a portable radiotelephone with a personal digital assistant. In a first mode of operation, the device operates as a conventional radiotelephone. In a second mode of operation, a personal digital assistant mode, the device permits the user to, for example, write and store notes, view previously stored notes, fax a note, send a note via electronic mail, and/or access the Internet. In an overlapping mode, while viewing a stored note in the personal digital assistant mode, a user can place a radiotelephone call and view the note during the call. However, this device employs at least two displays and two keypads - one display and keypad for use primarily in the radiotelephone mode and the other display and keypad for use primarily in the personal digital assistant mode. Such redundancy adds sufficient size and cost to the device.

Therefore, what is needed is a multi-mode communication device that permits a user to communicate in privacy and employs a single user interface having components carried on multiple surfaces of the device so as to minimize the size and cost of the device.

Brief Description of the Drawings

FIG. 1 is a circuit block diagram illustrating a communication system;

FIG. 2 is a front elevational view illustrating a communication device used in the communication system of FIG. 1 in a telephone mode;

FIG. 3 is a rear elevational view illustrating the communication device of FIG. 2;

FIG. 4 is a left side elevational view illustrating the communication device of FIG. 2;

FIG. 5 is a fragmentary cross sectional view illustrating the communication device of FIG. 2 taken across section lines 5-5 of FIG. 2 and with circuitry shown schematically;

FIG. 6 is a front elevational view illustrating a first housing of the communication device of FIG. 2 and a rear elevational view of a second housing of the communication device of FIG. 2 detached from the first housing;

FIG. 7 is a state diagram illustrating different modes of operation of the communication device of FIG. 2;

FIG. 8 is a front elevational view illustrating the second housing of the communication device of FIG. 2 in a video conferencing mode;

FIG. 9 is a front elevational view illustrating the second housing of the communication device of FIG. 2 in a note taking mode;

FIG. 10 is a front elevational view illustrating the communication device of FIG. 2 in a phonebook mode;

FIG. 11 is a front elevational view illustrating the communication device of FIG. 2 in a notes mode;

FIG. 12 is a front elevational view illustrating the communication device of FIG. 2 in a camera mode, a camera of the communication device being rotated to face backward; and

FIG. 13 is a fragmentary front elevational view illustrating the communication device of FIG. 1 in the camera mode, the camera of the communication device being rotated to face forward.

Detailed Description of the Preferred Embodiments

A communication device includes two housings, each containing circuitry operable when the communication device is in different modes. The communication device includes a latch for detachably coupling the two housings and permitting rotation of one housing with respect to the other. When the housings are attached and in a first alignment, the device operates in one mode. When the housing are attached and in a second alignment, the device operates in another mode. When the housings are detached, the device operates in yet another mode. By permitting detachment, the housings can be separately positioned as desired by a user. Also, user interface components of the communication device need not be positioned along a single surface of the device; thereby, helping to reduce the size of the device without reducing the device's utility.

The communication system 100 of FIG. 1 includes communication devices 102 and 104 that communicate over a communication link 106. The communication device 104 can be a wireless device, such as a cellular radiotelephone, a cordless telephone, a two-way radio, a modem, or the like, or the device can be a landline communication device, such as a telephone, a modem, a data terminal, or the like. The communication device 102 is any device compatible with the communication device 104, such as a dispatch center, a cellular base station, a cordless base, another telephone, a computer, or the like.

The communication link 106 can be a wireless connection or a wireline connection, such as a twisted wire pair, a coaxial cable, or the like. The communication link 106 supports data communications between the communication devices 102 and 104. Such data communications include cellular radiotelephone service, paging service, two-way radio service, electronic mail service, wireless fax service, short message service, or the like. In the illustrated embodiment, data is communicated via the wireless communication link 106 as radio frequency (RF) signal energy.

The communication device 104 includes a first portion of circuitry housed in a first housing 108. The first portion of circuitry comprises radio circuitry 114, image circuitry 115, a first user interface 116, and a first wireless data transceiver 117. The wireless data transceiver 117 is for communicating with a second portion of circuitry primarily housed in a second housing 110. The second portion of circuitry comprises a second wireless data transceiver 122, for communicating with the first wireless data transceiver 117, and a second user interface 123. A latch 112 detachably couples the housings 108 and 110. A controller 118 disposed in the housing 108 operates the communication device 104 in different modes responsive to signals generated by the latch 112, signals received from the communication device 102, and other signals input to the communication device 104 as described hereinbelow.

The communication device 104 includes power supplies 113 and 121. Although the individual connections are not shown, the power supply 113 supplies power to the circuitry of the housing 108. The power supply 113 is coupled to the power supply 121 through the latch 112, and to electrical contacts 120 carried on the housing 108. The power supply 121 supplies power to the circuitry of the housing 110. The power supplies 113 and 121 are preferably rechargeable batteries, but the power supply 113 can be a power regulator coupled to a conventional main power supply (e.g., a wall outlet alternating current power supply) and the power supply 121 can be a rechargeable battery charged by the power regulator of the power supply 113. Alternately, the power supplies 113 and 121 can be disposable batteries, or the like.

The radio circuitry 114 of the housing 108 includes an antenna 124, a RF transceiver 126, a channel modem digital signal processor (DSP) 128, and a speech processing DSP 130. The radio circuitry 114 and the controller 118 collectively comprise a radiotelephone. The antenna 124 receives incoming RF signals of the communication link 106 and converts the incoming RF signals into electrical receive signals output

on wire 134. Electrical transmit signals on wire 134 are emitted by the antenna 124 as outgoing RF signals of the communication link 106.

The RF transceiver 126 is coupled to the antenna via wire 134 and the controller 118 via bus 136. The RF transceiver 126, in response to control signals on bus 136, filters and steps down the electrical receive signals on wire 134 into electrical receive signals output on bus 138. The RF transceiver 126 is responsive to control signals on bus 136 to filter and amplify electrical transmit signals on bus 138 for emission by the antenna 124 via wire 134.

The channel modem DSP 128 is coupled to the RF transceiver 126 via bus 138 and to the controller 118 via bus 140. The channel modem DSP 128, in response to control signals on bus 140, demodulates and decodes electrical receive signals on bus 138 into receive compressed image data, receive speech data, or receive control data output on busses 142, 144, and 140, respectively. The channel modem DSP 128 is responsive to control signals on bus 140 to encode and modulate transmit compressed image data, transmit speech data, and/or transmit control data on busses 142, 144, 140, respectively, into electrical transmit signals on bus 138.

The speech processing DSP 130 is coupled to the channel modem DSP 128 via bus 144 and to the controller 118 via bus 146. The speech processing DSP 130, in response to control signals on bus 146, processes the receive speech data on bus 144 into electrical speech signals on wire 148. The speech processing DSP 130 is responsive to control signals on bus 146 to process electrical speech signals on wire 148 into transmit speech data on bus 144.

The user interface 116 of the housing 108 includes a speaker 149 and a microphone 151. The speaker 149 is coupled to the speech processing DSP 130 via wire 148. The speaker 149 transduces electrical speech signals on wire 148 into audible voice signals. Such signals can also constitute an audible alert to signal an incoming call. The microphone 151 is coupled to the speech processing DSP 130 via wire 150. The microphone 151 transduces audible voice signals into electrical speech signals on wire 150. The speaker 149 and the

microphone 151 are implemented using any suitable commercially available audio transducers.

The image circuitry 115 includes an image DSP 152 and an image memory 153. The image DSP 152 is coupled to the channel modem DSP 128 via bus 142 and the controller 118 via bus 154. The image DSP 152, in response to control signals on bus 154, decompresses receive compressed image data on bus 142 into receive decompressed image data on bus 156, decompresses compressed image data on bus 158 into receive decompressed image data on bus 156, and/or couples receive compressed image data on bus 142 to bus 158 as compressed image data. It will be recognized that decompressed image data refers to image data that was once, but no longer, compressed and image data that was never compressed. The image DSP 152 is responsive to control signals on bus 154 to compress transmit decompressed image data on bus 156 into transmit compressed image data on bus 142, compress transmit decompressed image data on bus 156 into compressed image data on bus 158, and/or couple compressed image data on bus 158 to bus 142 as transmit compressed image data. The image DSP 152 employs a conventional algorithm, such as the Motion Picture Experts Group (MPEG) algorithm available from C-Cube Inc.

The channel modem DSP 128, the speech processing DSP 130, and the image DSP 152 can be implemented using one, two, or more DSPs of the type that are commercially available. Alternatively, one or more microprocessors may be used.

The image memory 153 is coupled to the image DSP 152 via bus 158. The image memory 153 stores compressed image data received on bus 158. The image memory 153 permits retrieval of compressed image data by the image DSP 152 via bus 158. The image memory 153 is implemented using any suitable memory device such as a random access memory (RAM), an electrically erasable programmable read-only memory (EEPROM), or the like. The image memory 153 may be integral with the circuit used for the image DSP 152.

The wireless data transceiver 117 includes an infrared (IR) channel modem 160, an IR emitter 162 coupled to an output of the IR

channel modem 160, and an IR detector 164 coupled to an input of the IR channel modem 160. The IR channel modem 160 is coupled to the image DSP 152 via bus 156 and the controller 118 via bus 166. The IR channel modem 160, in response to control signals on bus 166, encodes and modulates receive decompressed image data received on bus 156 and forward control data received on bus 166 into a forward communication signal 168. The IR channel modem then drives the IR emitter 162 to transmit the forward communication signal 168. The IR channel modem 160 is responsive to control signals on bus 166 to permit reception of a backward communication signal 170 via the IR detector 164. The IR channel modem 160 demodulates and decodes the backward communication signal 170 into transmit decompressed image data on bus 156 and backward control data on bus 166. The IR emitter 162 can be implemented using a commercially available photodiode. The IR detector 164 can be implemented using a commercially available photodetector. The IR channel modem 160 can be implemented using appropriate analog and digital processing circuitry, such as that defined by IrDA (Infrared Data Association).

The wireless data transceiver 122 includes an IR channel modem 172, an IR emitter 174 coupled to an output of the IR channel modem 172, and an IR detector 176 coupled to an input of the IR channel modem 172. The wireless data transceiver 122 is compatible with the wireless data transceiver 117. The IR channel modem 172 demodulates and decodes the forward communication signal 168 received via the IR detector 176 into receive decompressed image data and forward control data on busses 178 and 182. The IR channel modem 172 encodes and modulates transmit decompressed image data on busses 180 and 182 and backward control data on bus 180 into the backward communication signal 170. The IR channel modem 172 drives the IR emitter 162 to transmit the backward communication signal 170. The IR channel modem 172 may alternatively route transmit decompressed image data directly from bus 182 to bus 178 in response to forward control data. The IR emitter 174, IR detector 176, and the IR channel

modem 172 can be implemented using circuit elements similar to those of the wireless data transceiver 117.

Although the illustrated communication between the housings 108 and 110 is accomplished via a wireless IR link, it will be recognized that the wireless data transceivers 117 and 122 can alternatively communicate via a wireless RF link or any other suitable wireless means. The wireless IR link transmits data at a rate of approximately 1 Mbit/sec to enable full motion video.

The user interface 123 includes a display 184 employing a touch sensitive screen (touchscreen) 186 and a charge coupled device (CCD) camera 188. The display 184 is coupled to the IR channel modem 172 via bus 178. The touchscreen 186 is coupled to the IR channel modem 172 via bus 180. The display 184 and the touchscreen 186 are configured by forward control data received on bus 178. Once configured, the display 184 displays receive decompressed image data and forward control data received on bus 178. Upon actuation, the touchscreen 186 produces both transmit decompressed image data and backward control data, such as mode selection data, on bus 180. The display 184 and the touchscreen 186 can be any conventional integrated display and touchscreen, such as those commercially available from Epson.

The CCD camera 188 of FIG. 1 is electrically coupled to the IR channel modem 172 via bus 182. The CCD camera 188 captures an image and outputs the image as receive decompressed image data on bus 182. The CCD camera 188 is housed in a third housing 189 coupled to the housing 110 via a swivel 190. The swivel 190 permits passage of the bus 182 therethrough so as to electrically connect the CCD camera 188 and the IR channel modem 172. The CCD camera 188 can be any conventional CCD camera, such as those manufactured and sold by Sharp.

The latch 112 physically couples the housings 108 and 110. The latch 112 permits rotation of, and detachment of, the housings 108 and 110. The latch 112 is electrically coupled to the controller 118 via bus 191. The latch 112 provides signals on the bus 191 indicating the position of the housing 110 relative to the housing 108 when the

housings 108 and 110 are attached. The latch 112 provides signals on the bus 191 indicating detachment of the housings 108 and 110, when the housings are detached. The latch 112 is described in greater detail hereinbelow.

The user interface 116 of the housing 108 also includes a plurality of actuatable switches 111. The switches 111 are coupled to the controller 118 by busses 125 and 127. Each terminal of the switches 111 is coupled to the controller 118 by a respective wire of bus 127. Bus 125 can be a single wire having a predetermined voltage thereon. Upon closure of one of the switches 111, a voltage on the bus 125 is transferred to a respective wire on bus 127 for sensing by the controller 118. The plurality of switches 111 includes a toggle switch 129, which is illustrated to be a double throw switch, a power switch 131, a photo switch 133, and a video switch 135.

The controller 118 can be implemented using a microprocessor 137 and a memory 139, a microprocessor having internal memory, a DSP, a programmable logic unit, or the like. The microprocessor 137 is coupled to the RF transceiver 126, the channel modem DSP 128, the speech processing DSP 130, the image DSP 152, the wireless data transceiver 117, the user interface 116, the latch 112, and the memory 139 via busses 136, 140, 146, 154, 166, 125, 127, 191, and 141, respectively. The microprocessor 137 is any suitable commercially available microcontroller or microprocessor, such as a 68332 microprocessor manufactured and sold by Motorola, Inc. The channel modem DSP 128, the speech processing DSP 130, and the image DSP 152 can be integrated with, or separate from, the controller 118. The memory 139 is an EEPROM, an erasable programmable read-only memory (EPROM), a random access memory (RAM), and/or any other suitable memory. The microprocessor 137 configures the display 184 and the touchscreen 186 with forward control signals output on bus 166. The forward control signals comprise data read from the memory 139 by the microprocessor 137 via bus 141. The microprocessor 137 is responsive to the position signal on bus 191 and mode selection data of

backward control signals on bus 166 to control the communication device 104 to operate in any of a plurality of different modes.

FIG. 2 illustrates that the housings 108 and 110 form a front surface 200 of the communication device 104. The housing 108 includes a longitudinal axis 208 and a transverse axis 210. The toggle switch 129 and the power switch 131 are disposed on the front surface 200 attributable to the housing 108. Actuation of the right side of the toggle switch 129 closes the double throw switch of FIG. 1 on the upper contact, while actuation of the left side of the toggle switch 129 closes the double throw switch on the lower contact. Actuation of the power switch 131 powers on the communication device 104 with the power supplies 113 and 121 of FIG. 1. The contacts 120 are disposed at a bottom of the housing 108, best seen in FIG. 2. The housing 110 includes a longitudinal axis 212 and a transverse axis 214. The display 184 and the touchscreen 186 are coextensive and comprise a majority of the front surface 200 attributable to the housing 110, thereby providing a relatively large area for viewing image data and inputting information. The front surface 200 attributable to the housing 189 includes a lens of the CCD camera 188.

The rear surface 300 (FIG. 3) of the communication device includes a plurality of openings 302 disposed in proximity to a top end. An opening 304 is disposed in proximity to a bottom end, opposite the top end. The speaker 149 of FIG. 1 is positioned behind the plurality of openings 302. The microphone 151 of FIG. 1 is disposed behind the opening 304. A user can place the rear surface 300 of the communication device 104 in close proximity to their head such that the plurality of openings 302 is juxtaposed with an ear and the opening 304 is juxtaposed with the mouth. In this position, the communication device 104 may be positioned in the manner of conventional telephone handsets for use in a telephone call.

With the housing 110 positioned in a recess 400 of the housing 108, the front surface 200 of the communication device 104 is substantially planar across the entire communication device 104, as best seen in FIG. 4. The housing 110 is held in the recess 400 by the latch

112, of which a turret 402 of the latch 112 is shown to extend from the housing 108 and into the recess 400.

FIGs. 5 and 6 illustrate that the turret 402 of the latch 112 carried on the housing 108 mates with a sleeve 502 of the latch 112 carried on the housing 110. The turret 402 employs a ledge 504. The ledge 504 encircles the turret 402. The ledge 504 includes a pair of opposing slots 600, each fitted with a spring-loaded ball plunger 506. One of the ball plungers 506 is an electrically conductive member electrically connected to a positive terminal (+) of the power supply 113 via an electrically conductive spring 507, a conductive contact 521, and a wire 523. The ball plungers 506 are outwardly biased with respect to the turret 402.

The turret 402 further includes a spring-loaded finger 508 positioned at a top surface 510 thereof. The spring-loaded finger 508 is an electrically conductive member electrically connected to a negative terminal (-) of the power supply 113 via an electrically conductive spring 511, a conductive contact 513, and a wire 515. The spring-loaded finger 508 is biased to extend outwardly with respect to the turret 402.

The turret 402 also includes sensors 512, 514, 604, and 606 positioned along a circular path 602 in the top surface 510. The sensors 512, 514, 604, and 606 are preferably magnetic reedswitches. The sensors 512, 514, 604, and 606 are electrically connected to the controller 118 via individual wires of the bus 191, as exemplified by sensors 512 and 514 in FIG. 5. When triggered, the sensors 512, 514, 604, and 606 output a logic high level signal by connecting a potential from the power supply 113 to the controller 118 via their respective wires of the bus 191. When untriggered, the sensors 512, 514, 604, and 606 do not output a logic high level signal and their respective wires of the bus 191 remain at a logic low level.

The sleeve 502 is integrally formed in a rear surface 519 of the housing 110. The sleeve 502 includes an electrically conductive cylindrical wall 518. The wall 518 is electrically coupled to a positive terminal (+) of the power supply 121 by wire 517. The sleeve 502 includes a pair of flanges 520 that are not electrically conductive and are

disposed to extend inward from the wall 518 at opposing locations thereof. The flanges 520 can be integrally molded with the housing 110. A top surface 522 of the sleeve 502 includes a conductive ring 524 that is electrically coupled to a negative terminal (-) of the power supply 121 via wire 525. The top surface 522 includes a trigger 526, such as a magnet, for actuating the sensor 512, 514, 604, or 606 when aligned therewith.

The housings 108 and 110 are movably attached by the latch 112. Upon aligning the flanges 520 of the sleeve 502 with the slots 600 and ball plungers 506 of the turret 402, the housing 110 is pressed against the housing 108. The flanges 520 impart a horizontal force on the ball plungers 506 and causes the ball plungers 506 to retract into the turret 402. Once the flanges 520 clear the ball plungers 506, the ball plungers 506 expand outward from the turret 402 and engage the wall 518 of the sleeve 502. This locks the flanges 520 between the ball plungers 506 and the housing 108. The spring, such as spring 507, disposed in each ball plunger 506 will remain partially compressed to ensure an electrical connection between the positive terminals of the power supplies 113 and 121. Also during assembly, the top surface 522 of the sleeve 502 becomes juxtaposed with the top surface 510 of the turret 402. The ring 524 of the sleeve 502 engages, and partially retracts, the spring-loaded finger 508 of the turret 402. The spring disposed in the finger 508 remains partially compressed when contacting the ring 524 to ensure an electrical connection between the negative terminals of the power supplies 113 and 121. The spring force exerted by the finger 508 is comparatively small relative to that exerted by the ball plungers 506. This prevents the finger 508 from pushing the turret 402 out of the sleeve 502.

Once assembled, the axes of the housing 110 are aligned with the axes of the housing 108, as shown in FIG. 2. In this orientation, the longitudinal axes 208 and 212 of the housings 108 and 110, respectively, and the transverse axes 210 and 214 of the housings 108 and 110, respectively, are parallel. The sensor 512 of the turret 402 is actuated by the trigger 526, as shown in FIG. 5, and outputs the logic high level

signal to the controller 118 via its respective wire of the bus 191. The sensors 514, 604, and 606 are untriggered and their respective wires of the bus 191 remain at a logic low level.

The housing 108 can be rotated ninety degrees to a ninety degree orientation, as shown in FIG. 12. As the housing 110 is rotated, the flanges 520 of the sleeve 502 are drawn under the ledge 504 of the turret 402. During rotation, the ball plungers 506 of the turret 402 maintain contact with the wall 518 of the sleeve 502. Also, the spring-loaded finger 508 of the turret 402 travels about, and maintains contact with, the ring 524 of the sleeve 502. The trigger 526 travels along the path 602.

In the ninety degree orientation, the longitudinal axis 212 (FIG. 2) of the housing 110 is perpendicular to the longitudinal axis 208 of the housing 108. The transverse axis 214 of the housing 110 is perpendicular to the transverse axis 210 of the housing 108. The sensor 604 is aligned with the trigger 526 and outputs the high logic level signal to the controller 118 via its respective wire of the bus 191. In this orientation, the sensors 512, 514, and 606 are untriggered and their respective wires of the bus 191 remain at a logic low level.

From the ninety degree orientation, the housing 110 can be further rotated ninety degrees in either the counterclockwise direction to a 180 degree orientation shown in FIG. 13 or a clockwise direction back to the orientation shown in FIG. 2. In the 180 degree orientation, only sensor 514 is aligned with the trigger 526 and outputs the high logic level signal on its respective wire of the bus 191. From the 180 degree orientation, the housing 110 can be rotated another ninety degrees in either the counterclockwise direction to a 270 degree orientation or a clockwise direction back to the ninety degree orientation. In the 270 degree orientation, the housing 110 can be rotated another ninety degrees in either the counterclockwise direction to the orientation shown in FIG. 2 or a clockwise direction back to the 180 degree orientation. In the 270 degree orientation, only sensor 606 is aligned with the trigger 526 and outputs the logic high level signal on its respective wire of the bus 191.

To detach the housings 108 and 110, the housing 110 is rotated to the orientation shown in FIG. 2 such that the flanges 520 reside under the ball plungers 506 and the trigger 526 is aligned with sensor 512, as shown in FIG. 5. Detachment is accomplished by pulling the housings 108 and 110 apart with a force that is sufficient to cause the flanges 520 to retract, and move past, the ball plungers 506. Once detached, all of the sensors 512, 514, 604, and 606 are untriggered and all wires of the bus 191 are at the logic low level. Also, the electrical connection between the power supplies 113 and 121 is broken such that the circuitry in the housing 110 is solely powered by the power supply 121.

Upon detection of actuation of the power switch 131 on bus 127 and detection of the logic high level signal from the sensor 512 on the bus 191 from positioning the housings 108 and 110 as shown in FIG. 2, the controller 118 powers on, and configures, the communication device 104 in a telephone mode 700 of FIG. 7. In this mode, the controller 118 configures the display 184 (FIG. 2) to display a telephone keypad 206, a darkened telephone softkey 202, a phonebook softkey 203, a notes softkey 204, and a camera softkey 205. Telephonic communication is initiated via reception of a call or placement of a call. An incoming call is received by the user touching the touchscreen 186 at the telephone softkey 202 in response to an incoming call alert from the speaker 149 of FIG. 1. A call is placed by touching the display 184 at the numbers of the telephone keypad 206 to enter a desired phone number. Alternatively, placement of a call using a stored telephone number can be performed via a phonebook mode 702 (FIG. 7), as is discussed in greater detail with respect to FIG. 10 below.

Upon detection, during a call, of detachment of the housings 108 and 110 from the logic low level on all wires of the bus 191 and touching the touchscreen 186 at the camera softkey 205 via bus 166, the controller 118 configures the communication device in a video conferencing mode 730 of FIG. 7. The transition from the telephone mode 700 to the video conferencing mode 730 is represented by arrow 729.

In the video conferencing mode 730, the controller 118 configures the display 184 (FIG. 8) to display the softkeys 202-205 with the telephone softkey 202 and the camera softkey 205 darkened. The controller 118 displays a second user 802, with which the instant user is telephonically communicating, on the display 184. In this mode, the housing 110 can be positioned a distance from the housing 108. This permits viewing of the second user 802 on the display 184 and aiming of the CCD camera 188 for capture of the instant user's image for transmission to, and similar viewing by, the second user 802 while the housing 108 is positioned against the user's head. In noisy environments, or where privacy is desired, audible communication via the speaker 149 and the microphone 151 are enhanced by close positioning of the housing 108 while viewing and image capture is enhanced by the remote positioning of the second housing 110. Upon detection of touching the touchscreen 186 at the telephone softkey 202 via bus 166, the controller 118 returns the communication device 104 to the telephone mode 700 (FIG. 7). The transition from the video conferencing mode 730 to the telephone mode 700 is represented by arrow 731.

Upon detection, during a call, of detachment of the housings 108 and 110 from the logic low level on all wires of the bus 191 and touching the touchscreen 186 at the notes softkey 204 via bus 166, the controller 118 configures the communication device in a note taking mode 732 of FIG. 7. The transition from the telephone mode 700 to the note taking mode 732 is represented by arrow 733.

In the note taking mode 732, the controller 118 configures the display 184 (FIG. 9) to display a menu level icon 902, provide a tablet area 904, and display the softkeys 202-205 with the telephone softkey 202 and the notes softkey 204 darkened. In this mode, the housing 110 can be positioned a distance from the housing 108. For example, the housing 110 can be positioned on a table while the housing 108 is positioned against the user's head. This facilitates entry of a handwritten note 906 on the tablet area 904 of the touchscreen 186 of the housing 110 while the housing 108 is positioned along between the

user's ear and mouth to permit audible communication via the speaker 149 and the microphone 151. The handwritten note 906 is written by writing on the tablet area 904 of the touchscreen 186 with a stylus or other suitable device. Upon detection of touching the touchscreen 186 at the menu level icon 902 via bus 166, the controller 118 reconfigures the display 184 to display additional functions of the communication device 104 for accessing. For example, actuation of the menu level icon 902 can access the notes mode 704 of FIG. 7, which allows storage of the handwritten notes or creation of additional notes, as described in greater detail with respect to FIG. 11 below. Upon detection of touching the touchscreen 186 at the telephone softkey 202 via bus 166, the controller 118 returns the communication device 104 to the telephone mode 700 (FIG. 7). The transition from the note taking mode 732 to the telephone mode 700 is represented by arrow 734.

Upon detection of touching the touchscreen 186 at the telephone softkey 202 via bus 166, the controller 118 terminates an active call in the telephone mode 700. Upon detection of touching the touchscreen 186 at the phonebook softkey 203 or at the notes softkey 204 while a call is not active, the controller 118 transitions operation of the communication device 104 from the telephone mode 700 (FIG. 7) to the phonebook mode 702 or the notes mode 704, respectively, as represented by respective arrow 708 or 710. Upon detection of the logic high level signal from the sensor 604 or 606 via bus 191, the controller 118 transitions operation of the communication device 104 from the telephone mode 700 to the camera mode 706 as represented by arrow 712.

In the phonebook mode 702, the controller 118 configures the display 184 (FIG. 10) to display the softkeys 202-205 with the phonebook softkey 203 darkened, the message "phonebook" followed by a list of names 1002, and a menu level icon 1004. The list of names 1002 is stored in the memory 139 of the controller 118 along with corresponding telephone numbers. Upon detection of touching the touchscreen 186 at the phonebook softkey 203 while a name (such as "Michael Smith" in FIG. 10) is highlighted by a cursor 1006, the

controller 118 retrieves a telephone number associated with the name. Upon detection of right and left actuation of the toggle switch 129 via bus 127, the controller 118 configures the display 184 to move the cursor 1006 up and down the list of names 1002, respectively. Upon detection of touching the touchscreen 186 at the menu level icon 1004, the controller 118 accesses additional functions of the phonebook mode 702, such as storing names and corresponding telephone numbers. Upon detection of touching the touchscreen 186 at the telephone softkey 202 or at the notes softkey 204 via bus 166, the controller 118 transitions operation of the communication device 104 from the phonebook mode 702 (FIG. 7) to the telephone mode 700 as represented by arrow 713 or the notes mode 704 as represented by arrow 714, respectively. Upon detection of the logic high level signal from the sensor 604 or 606 via bus 191, the controller 118 transitions operation of the communication device 104 from the phonebook mode 702 to the camera mode 706 as represented by arrow 716.

In the notes mode 704, the controller 118 configures the display 184 (FIG. 11) to display the softkey 202-205 with the notes softkey 204 darkened and the message "notes" followed by a list of functions 1102. The list of functions 1102 is stored in the memory 139 of the controller 118. Upon detection of touching the touchscreen 186 at the notes softkey 204 while a function (such as "Save Note") is highlighted by a cursor 1104, the controller 118 executes the function. Upon detection of right and left actuation of the toggle switch 129 via bus 127, the controller 118 configures the display 184 to move the cursor 1104 up and down the list of functions 1102, respectively. The "Save Note" function is also accessible from the note taking mode 732 (FIG. 9) via actuation of the menu level icon 902 as previously described. During execution of the "Save Note", the controller 118 stores a note, such as the handwritten note 906 written during the note taking mode 732, in the image memory 153 (FIG. 1). Also upon execution of a function, the controller 118 may configure the display 184 to display additional executable functions, such as, entry of an alphanumeric name for naming the note. Upon detection of touching the touchscreen 186 at

the telephone softkey 202 or at the phonebook softkey 203 via bus 166, the controller 118 transitions operation of the communication device 104 from the notes mode 704 (FIG. 7) to the telephone mode 700 as represented by arrow 718 or the phonebook mode 702 as represented by arrow 720, respectively. Upon detection of the logic high level signal from the sensor 604 or 606 via bus 191, the controller 118 transitions operation of the communication device 104 from the notes mode 704 to the camera mode 706 as represented by arrow 722.

In the camera mode 706, the controller 118 configures the display 184 (FIGs. 12 and 13) to display the softkeys 202-205 with the camera softkey 205 darkened. In FIG. 12, the housing 110 has been rotated ninety degrees to the ninety degree orientation, as represented by arrow 1204. Upon detection of the logic high level signal from the sensor 604 via bus 191, the controller 118 controls the wireless data transceiver 122 of housing 110 to route image data captured by the CCD camera 188 directly to the display 184 in a landscape orientation 1202. Rotation of the housing 110 allows the housing 189 to rotate on the swivel 190. The swivel 190 permits the housing 189 to be positioned at any angle between zero degrees and 360 degrees with respect to the housing 110. In FIG. 12, the housing 189 has been rotated on the swivel 190 180 degrees, as described by arrow 1206. In this position, the lens of the CCD camera 188 faces rearward and captures an image 1200 located physically behind the communication device 104, i.e., the face of a person facing the rear surface 300 (FIG. 3) of the communication device 104.

In FIG. 13, the housing 110 has been rotated an additional 90 degrees to the 180 degree orientation, as described by arrow 1304. Upon detection of the logic high level signal from the sensor 514 via bus 191, the controller 118 controls the wireless data transceiver 122 of housing 110 to route image data captured by the CCD camera 188 directly to the display 184 in a portrait orientation 1302. The housing 189 has been rotated on the swivel 190 an additional 180 degrees, as described by arrow 1306. In this position, the lens of the CCD camera 188 faces forward, out of the page, and captures an image 1300 located in front of

the communication device 104, i.e., facing the front surface 200 (FIG. 2) of the communication device 104.

In the camera mode 706, the photo switch 133 and the video switch 135, which are disposed in the recess 400 of the housing 108, are revealed. Upon detection of actuation of the photo switch 133 via bus 127 (FIG. 1), the controller 118 controls the wireless data transceivers 117 and 122 to couple transmit image data captured at an instant in time by the CCD camera 188 to the image DSP 152 for storage in the image memory 153 as a photo snapshot. Upon detection of actuation of the video switch 135 via bus 127 (FIG. 1), the controller 118 controls the wireless data transceivers 117 and 122 to initiate coupling of transmit image data captured by the CCD camera 188 to the image DSP 152 for storage in the image memory 153 as a video clip. Upon detection of an additional actuation of the video switch 135, the controller 118 controls the wireless data transceivers 117 and 122 to terminate coupling of the transmit image data. Upon detection of right and left actuation of the toggle switch 129 via signals on bus 127, the controller 118 configures the display 184 to display the images 1200 and 1300 zoomed-in and zoomed-out, respectively. Upon detection of touching the touchscreen 186 at the camera softkey 205, the controller 118 configures the display 184 to display a list of camera functions (similar to the list of functions 1102, FIG. 11, of the notes mode 704) that permit, for example, assigning a name to or retrieving photo snapshots and video clips stored in the image memory 153. Upon detection of the logic high level signal from the sensor 512 via bus 191 and touching of the touchscreen 186 at the telephone softkey 202, the phonebook softkey 203, or the notes softkey 204, the controller 118 transitions from the camera mode 706 (FIG. 7) to the telephone mode 700 as represented by arrow 724, the phonebook mode 702 as represented by arrow 726, or the notes mode 704 as represented by arrow 728, respectively.

Thus it can be seen that a multi-mode communication device employs two separable housings detachably coupled via a rotatable latch. When the housings are attached in a first orientation, the device operates in a first mode, such as a telephone mode. In the first mode,

the device can be placed in a calling state. When the housings are attached and in a second orientation, the device operates in a second mode of operation, such as a camera mode. When the housings are detached during a calling state, the device operates in a third mode, such as a note taking mode. In the second and third modes, an image is captured and a plurality of image data is generated therefrom. By permitting detachment, one housing can be positioned at a distance while the other housing can be maintained in close enough proximity for the user to participate in a call. This is beneficial in noisy environments or when privacy is necessary. Detachment also allows disposal of the user interface across multiple surfaces of the device, thereby, minimizing the size of multi-mode communication devices.

What is claimed is:

Claims

1. A communication device comprising:

a first housing;

a first portion of circuitry positioned in the first housing to operate the communication device in a plurality of different modes;

a second housing;

a second portion of circuitry positioned in the second housing to operate with the first portion of circuitry; and

a latch detachably coupling the first and second housings, the first and second portions of circuitry operating the communication device in a first one of the plurality of different modes when the first and second housings are coupled, and the first and second portions of circuitry operating the communication device in a second one of the plurality of different modes when the first and second housings are detached.

2. The communication device according to claim 1 wherein the second portion of circuitry comprises a camera to capture an image and generate a plurality of image data in the second one of the plurality of different modes.

3. The communication device according to claim 2 wherein

the first portion of circuitry comprises a radiotelephone,

the second portion of circuitry comprises a display, and

the second one of the plurality of different modes comprises a video conferencing mode, the video conferencing mode permitting positioning of the first housing along a head of a user, and remote positioning of the second housing to permit capture of an image of the user by the camera and to permit viewing of an image of another user on the display by the user.

4. The communication device according to claim 1 wherein the second portion of circuitry comprises a touchscreen to capture an image and generate a plurality of image data in the second one of the plurality of different modes.

5. The communication device according to claim 4 wherein

the first portion of circuitry comprises a radiotelephone, and

the second one of the plurality of different modes comprises a note taking mode, the note taking mode permitting positioning of the first housing along a head of a user, and remote positioning of the second housing to permit capture of an image written by a user on the touchscreen.

6. A communication device comprising:

a first housing comprising a first longitudinal axis;

a first portion of circuitry positioned in the first housing to operate the communication device in a plurality of different modes;

a second housing comprising a second longitudinal axis;

a second portion of circuitry positioned in the first housing to operate with the first portion of circuitry; and

a latch rotatably coupling the first and second housings, the first and second portions of circuitry operating the communication device in a first one of the plurality of different modes when the first and second longitudinal axes are substantially parallel, and the first and second portions of circuitry operating the communication device in a second one of the plurality of different modes when the first and second longitudinal axes are substantially perpendicular.

7. The communication device according to claim 6 wherein the second portion of circuitry comprises a camera to capture an image and generate a plurality of image data in the second one of the plurality of different modes.

8. The communication device according to claim 7 wherein

the first portion of circuitry comprises an image memory and a first wireless data transceiver coupled to the image memory, and

the second portion of circuitry comprises a second wireless data transceiver coupled to the camera, the first and second wireless data transceivers to communicate the plurality of image data from the camera to the image memory.

9. The communication device according to claim 7 further comprising a third housing rotatably mounted to the second housing, the camera being carried on the third housing.

10. The communication device according to claim 6 further comprising a switch disposed on the first housing, the switch being hidden for the first one of the plurality of different modes and revealed for the second one of the plurality of different modes.

Patent Office

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Claims searched:	1-5	**Date of search:**	12 August 1997

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H4J (JK), H4L (LECX)

Int Cl (Ed.6): H04M (1/02, 1/60, 1/62, 1/72), H04B (1/38)

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A, P	GB 2301467 A	(MOTOROLA) see whole document	
A, P	GB 2297661 A	(MOTOROLA) see whole document and particularly page 10, lines 3-25	1
A	US 5414444	(BRITZ) see whole document	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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